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April 5, 1962

Dear Gene:

Wendell asked that we provide some information we might have on possible development items to be included in the FY 63 Budget. In addition, in view of recent complaints, it is probably wise to indicate areas where quality and output can be improved to help answer questions that may arise.

We, therefore, have drawn together the attached summary of where we stand and where we think improvements might be made or undertaken.

I am sending a copy of this to Wendell to provide backup for the FY 63 Budget and am enclosing an extra copy for you with the thought that Pete S. might be interested in a thumbnail sketch of the situation.

ELG/MDG

E. L. G.

cc: WM
CFH
EJB
ABS
JLB

April 3, 1962

Analysis of Improvements in Film Handling

The outstanding characteristics of the trend in aerial reconnaissance are:

1. Constantly (and drastically) increasing volume of original photography. This is being accomplished both by increases in the footage per mission and by an increased number of successful missions per unit time.

2. Continued emphasis on increased information content per unit area of original film.

3. These two factors require more and more analysts to exploit the material which in turn dictate more copies of the original material.

Consequently, the volume of processing and reproduction work is large and growing much larger from day to day. Paradoxically, this increase in volume is attended not only by a requirement for greater speed in delivery but by a demand for the greatest fidelity in the reproductions. These two requirements, speed and quality, are not normally compatible except with multiplying the number of machines and the number of operators. It takes only money, although substantial amounts may be involved, to provide sufficient machines and facilities. Film processing and reproduction, while capable of being automated to some degree, will always depend very largely on the skill and training of the individual operator. Such skilled people are, as is true in so many instances, in short supply and they cannot be trained in a short time. Ergo, it appears axiomatic that we must concentrate our efforts on speeding up our machines, improving quality, reducing physical defects, combining operations, etc., so as to reduce the need for manpower or at least minimize the amount of increased manpower to handle the increased loads.

We summarize below the more important areas on which emphasis should be placed and will elaborate on each item in an appendix:

1. Better physical facilities to provide closer atmosphere control and reduce dirt.

2. Improved methods of processing original negative films to retain latent imagery, compensate for exposure errors, reduce distortions, etc.

3. Improved duplicating processors particularly as regards speed and reduction of physical damage. Doubling the speed of a duplicating machine is, as a rough example, worth about $150,000 per year in terms of labor, burden and facility cost.

4. Construction of reversal processors to minimize losses in printing successive generations.

5. Development of high speed printers utilizing one or more methods of exposure control to compensate for errors of exposure or of development of the original negative.

6. Development of high quality reduction systems to ease the storage problems of the intelligence community. Such problems will be greatly magnified by the previously mentioned trend toward large volume.

7. Improved control equipment for the rapid and accurate analysis of large volumes of films.

8. Provide image enhancement systems to assist the P.I. in extracting the maximum information from the films.

9. Provide "latensification" methods in practical form to assist in extending the photographic "season" particularly in northern latitudes.

10. Develop equipment to speed up and ease P.I. analysis of large volumes of film.

11. Provide faster and more economical, in terms of manpower, methods of accomplishing the many auxiliary functions required in reproduction such as titling, waxing, lacquering and cleaning.

Following in Appendix I is a more detailed discussion of each of the above categories. In Appendix II is an R.O.M. cost estimate for each item. Except where indicated otherwise the costs cover the design, development, and the fabrication of one prototype or engineering model. It is recognized that the proposed expenditures of $7,700,000 are perhaps in excess of both funding capability and our ability to engineer. Further investigation will undoubtedly indicate areas of redundancy or where the results will not justify the cost.

Appendix I
Discussion of Possible Improvements in Film Handling

1. Better Physical Facilities. The present facility was designated in late 1955 to have a life of one year. Furthermore, by today's standards, the expected photography was both large scale and low resolution. Today and, more importantly, in the future, atmospheric dust and dirt from the surroundings and equipment will be intolerable in introducing loss of information and degradation of the product. It is proposed that the entire facility be moved to a building or buildings more adapted to the control of such dirt and that the facility be reconstructed utilizing techniques to minimize both dirt formation and cleaning problems.

2. Improved Negative Processors. The present negative processors were adapted, because of schedule limitations, from existing equipment. The development technique selected was adequate for the large scale photography with slowly changing levels of illumination then in use. Today the systems utilize small scale photography with rapidly changing light levels. Therefore, emphasis must be placed on developing controls capable of analyzing this small scale photography and directing additional development.

   Among the various "new" methods of processing film are such techniques as web, viscous, static, and vapor development. While each gives indications of offering some improvement in retention or enhancement of available imagery, none have been tried on wide widths and long continuous lengths. It is suggested that the best approach be determined and that an experimental machine be constructed.

   The intelligence community is insisting more and more on their duplicates containing all of the information on the original. Generally speaking, this requires that every duplicate be made from the original with the resultant possibility of wear and tear on this valuable property. One way of minimizing such damage would be to lacquer and lubricate the original film. To minimize handling damage, reduce time and conserve manpower, it seems logical to perform this operation while the negative is still on the processing machine. Therefore, this provision should be a part of the next processor.

   Compounded by many factors such as world tension, high volume, frequent missions, limited manpower, etc; there is a desire for quick reporting on the superficial aspects of each mission. This reporting cannot be done from the original negative without the possibility of degrading it. A duplicate takes time

to make and holds up distribution both of the flash report and of the multiple copies to the community. It is considered possible to combine a printer and duplicating processor with the negative so that a positive transparency would be available in a matter of minutes after the negative was processed.

3. Improved Duplicating Processors. The present duplicating machines available to this project illustrate the "Topsy" principle at its worst. They are three in number and each one is constructed in different fashion, each has its own idiosyncracies, and each has been modified innumerable times to keep up with physical and sensitometric requirements. They started out at 10 fpm and now run at 29 fpm on certain products. We are currently processor limited in terms of output.

It is proposed that all three be replaced with three identical machines incorporating every known principle of reducing damage and achieving uniformity and at the same time aim at an output speed of 50 to 60 fpm each. At the same time, to combine operations and reduce damage in subsequent handling, we would add waxers to these machines.

4. Reversal Processors. Recent tests on the prototype reversal processor indicate that considerable improvement in retention of original information is possible when preparing duplicate negatives directly from the original negative instead of by the conventional method of printing and processing a duplicate positive and then making a duplicate negative from this positive. Should extensive evaluation by the users, such as NPIC, corroborate this finding, it is considered essential that reversal processors be provided. Further improvements in techniques may also make it possible to prepare duplicate positives from such duplicate negatives of quality comparable to those now prepared from the original negative. An extension of this technique might also result in reversal processing of the original negative so that the positives retain their status of second generation prints.

5. High Speed Printers incorporating exposure control. Present high performance printers either do not provide for automatic control of exposure (ours) or achieve exposure control and dodging at the expense of speed (Log-E-Tronics). Even with the latter printers, it is doubtful if the concept will adequately handle the projected scales and resolutions. It is believed possible, by combining what we know now of film transports, cleaning methods, light sources and scanning and control techniques, to provide printers of much improved performance. With the increased volume and increased dependence on duplicates, such printers are a necessity.

6. Reduction Systems. With the advent of such large volumes of photography, the storage problems of various sectors of the community will become acute. The anticipated resolution and

information content of the photography does not lend itself to the 20 to 1 reduction rates of Minicard and other systems, but the development of a high performance 3.5 or 4 to 1 continuous reducing printer would permit the collapsing of the required storage space by a factor of 10 to 15 without sacrifice of the convenience of the original roll format. Other parts of the "system" such as viewers, enlargers and processors need no development except modification to "marry" them to the requirements.

7. Improved Control Equipment. One of the more critical operations in film reproduction is the analysis of the original negative to determine future operations. This is largely a densitometer technique and there are several current approaches none of which are suited to large volume small scale photography. It is proposed that a high scanning speed indicating and recording microdensitometer be developed utilizing and combining known techniques modified by the requirements.

Analysis of sine wave response is an extremely useful tool in determining the performance of a system or any of its components. Currently, however, the reduction of such data to interpretable results is so laborious and time consuming as to limit the use of the technique to predicting performance or the analysis of a few specified conditions rather than for day to day monitoring. It is proposed that effort be placed on simplifying and mechanizing much of these operations.

8. Image Enhancement. With reduced contrast, reduced scale, increased magnification and the like, the P.I. requires all the assistance he can obtain in the recognition, identification and measurement of what images are available. Methods of locally enhancing images are available and utilized by the various laboratories, but the required volume of this work will shortly make the methods too laborious to be of satisfactory use. Then, also, under present conditions one must know what areas need image enhancement. In many cases this is impossible to determine. It is, therefore, necessary to develop methods of large quantity image enhancement as well as more rapid and more perfect enhancement of selected areas.

9. Latensification. "Speed" of optical systems will always be limited by the weight and performance capabilities of the vehicle. Speed and small grain (resolving) capabilities of film will always be mutually competing. Consequently, there is always less "available light" than is desired for the practical lens-film-vehicle combinations. One possible solution is to latensify or intensify the latent images after exposure. Such a technique is available in the laboratory and it is necessary only to reduce it to large volume practice.

10. Equipment for P.I. Analysis. Much of the equipment in this field has been developed in sporadic and spasmodic fashion influenced by both the immediate needs and the offerings of manufacturers. Consequently, there are redundant items as well as gaps in filling the requirements of present systems. And future systems promise to provide even more problems. It is thought that there should be a thorough analysis of what is available and a comprehensive prediction of what is required. As examples we believe consideration should be given to high speed continuous enlarging printers to bring resolution down to useable levels and to methods of providing "quick" enlargements for immediate use. The recommendations should cover not only what is needed in the way of physical equipment, but what can be done to simplify the P.I. load. For here, again, we are rapidly reaching the bottom of the manpower barrel.

11. Auxiliary Equipment. The auxiliary or "dry-handling" equipment in use in our laboratory today, while considered the best available, has many shortcomings particularly in the fields of output and utilization of manpower. This situation has arisen because the need for specific items of equipment has been recognized at separate intervals. Furthermore, each operation was one never attempted before at this magnitude and development proceeded slowly and cautiously. The time has come to examine all of these operations, improve them, automate them where possible, combine them and speed them up.

Appendix II
R.O.M. Costs
Improvements in Film Handling

1.	Better Physical Facilities		$ 2,500,000
2.	Improved Negative Processors		1,250,000
	A. Control System	$ 100,000	
	B. New methods	400,000	
	C. Lacquering	150,000	
	D. Combined Processor Printer-Processor	600,000	
3.	Improved Duplicating Processors (3)		800,000
4.	Reversal Duplicating Processors (2)		600,000
5.	High Speed Printers (2)		350,000
6.	Reduction Printer		300,000
7.	Improved Control Equipment		350,000
	A. Densitometer	250,000	
	B. Sine Wave Response Simplification	100,000	
8.	Image Enhancement		250,000
9.	Latensification		100,000
10.	P.I. Equipment		600,000
11.	Auxiliary Equipment (2 sets)		600,000
		R.O.M. Total	$ 7,700,000

April 24, 1962

Dear Ed:

This is a reiteration and enlargement of message number 4189 sent you today and deals with the information desired for TAB A of JQR report. It should be emphasized that the figures not only are R.O.M., but to some extent they will be dependent on how closely we can "weld" or "marry" to the other installation which you are aware. This is particularly true of line item (a) and true to a lesser degree of line item (b). Line item (d), on the other hand, is not affected by interrelationship.

		FY 62	FY 63	FY 64
(a)	Establish Processing Facility	$50,000	$1,950,000	$500,000
(b)	Provide New Equipment:			
	Negative Processor (1)	10,000	300,000	90,000
	Duplicating Processors (3)	20,000	500,000	80,000
	Reversal Processors (2)		400,000	250,000
	Printers (2)	10,000	240,000	
	Reduction Printer		50,000	250,000
	Auxiliary Equipment	20,000	350,000	230,000
(c)	Staff	As required by operations.		
(d)	Development:			
	Negative Processing	20,000	100,000	630,000
	Control Equipment		100,000	350,000
	Image Enhancement		100,000	320,000
	Latensification		100,000	100,000
	P.I. Aids		200,000	400,000
	Totals	$130,000	$4,390,000	$3,200,000

The estimated expenditures for FY 62, while small, should not be disregarded. These represent engineering, design, and preliminary development studies and will gain us time if they can be started in FY 62. Therefore, if you can authorize immediately the expenditure of $130,000 or any major fraction thereof, we can start now and save two months. Until we do some of this type of work, we will be unable to provide any closer estimates.

E. L. G.

ELG/MDG
Orig. + 2 cc E.F.
cc: A.B.S.
J.L.B.